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Equipment

An overview of adult resuscitation equipment

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Conflict of interest

None declared

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This article has been subject to external double-blind peer review and checked for plagiarism using automated software

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Abstract

The nurse has many roles and responsibilities in relation to cardiopulmonary resuscitation (CPR) including: recognising the deteriorating patient; recognising cardiac arrest and commencing CPR

while waiting for the resuscitation team to arrive; ensuring that the contents of the resuscitation trolley are present, in date and in full working order; and completing audit data for the National Cardiac Arrest Audit in participating healthcare organisations.

Many incidents involving crash trolley equipment and resuscitation have been reported to the National Patient Safety Agency (NPSA) (2008) and predominantly relate to lack of equipment, missing equipment and inadequately stocked trolleys. The aim of this article is to update the practitioner's knowledge of the contents of a standard resuscitation trolley. The article describes the items contained in the resuscitation trolley and provides a rationale for their use and inclusion. The importance of checking and restocking the resuscitation trolley is discussed, along with the importance of recording CPR efforts in documentation. The National Cardiac Arrest Audit is also highlighted.

cardiac arrest trolley, cardiopulmonary resuscitation, CPR, resuscitation, resuscitation equipment

Aims and intended learning outcomes

The aim of this article is to update the practitioner's knowledge of the contents of a standard resuscitation trolley found within adult clinical areas. The article describes the items contained in the resuscitation trolley and provides a rationale for their use and inclusion. The importance of checking and restocking the resuscitation trolley is discussed, as well as the importance of recording and documentation of cardiopulmonary resuscitation (CPR) efforts. The National Cardiac Arrest Audit is also highlighted.

After reading this article and completing the time out activities you should be able to:

- Describe the layout of a standard resuscitation trolley within the context of a systematic approach to patient assessment and management.
- List the equipment commonly found on or around the resuscitation trolley and summarise the clinical application for each item.
- Outline the procedure for checking and restocking the resuscitation trolley.
- Explain the stepwise approach to airway management and identify appropriate airway adjuncts.
- Correctly identify the equipment required for endotracheal tube intubation.
- Identify the first-line drugs routinely used in cardiac arrest and discuss their role in resuscitation.
- List and describe the routes for drug administration during resuscitation and explain the role of the nurse in relation to intravenous therapy.
- Summarise the nurses' role in documentation and record-keeping in relation to cardiac arrest.

Introduction

The nurse has many roles and responsibilities in relation to CPR including:

- Recognising the deteriorating patient.
- Recognising cardiac arrest and commencing CPR while waiting for the resuscitation team to arrive.
- Ensuring that the contents of the resuscitation trolley are present, in date and in full working order.
- Completing audit data for the National Cardiac Arrest Audit in participating healthcare organisations.

Many incidents involving crash trolley equipment and resuscitation have been reported to the National Patient Safety Agency (NPSA) (2008) and predominantly relate to a lack of equipment, missing equipment and inadequately stocked trolleys. The knowledge, choice and assembly of the equipment required for cardiac arrest is vital in delivering safe patient care. The aim of this article is to update the practitioner's knowledge of the contents of a standard resuscitation trolley. The article describes the items contained in the resuscitation trolley and provides a rationale for their use and inclusion. The importance of checking and restocking the resuscitation trolley is discussed, and so is the importance of recording CPR efforts in documentation. The National Cardiac Arrest Audit is also highlighted.

The Resuscitation Council UK (RCUK) has published guidelines for adult, basic life support and advanced life support **[Q3. Should this be "guidelines for basic and advanced life support in adults" or is adult a separate category?]**, including advice on airway management, chest compressions, defibrillation and drugs administration (RCUK 2015). Not all aspects of resuscitation are based on high quality evidence from clinical trials. This can be explained by the ethical challenges of conducting research in the context of cardiac arrest. Consequently, some of the content of this article represents consensus expert opinion from the most contemporary guidelines. The RCUK (2014) have also published quality standards for CPR practice and training, and one of the core standards relates to appropriate equipment being available for resuscitation.

TIME OUT 1

To fully understand the clinical application of the resuscitation equipment, it is essential to have an optimal knowledge of the resuscitation guidelines. Before proceeding, review the procedure for assessing the collapsed patient and delivering in-hospital basic life support, which can be found at www.resus.org.uk.

The Resuscitation Trolley and Associated Equipment

In the event of in-hospital cardiac arrest, clinical staff should have immediate access to resuscitation equipment and appropriate drugs (RCUK 2015). It is worth noting that guidelines for community or pre-hospital resuscitation differ from in-hospital protocols. Further information regarding community-based resuscitation can be found on the RCUK website at www.resus.org.uk. The layout of equipment used for resuscitation, including the defibrillator, should be standardised throughout the local healthcare organisations. In addition, all staff should be familiarised with the equipment available, the procedures for escalation of a deteriorating patient **[Q4. Do you mean "escalation of treatment of a deteriorating patient"]** and the initial management of a patient in cardiac arrest.

The following sequence should be followed when assessing a patient who appears to have collapsed (DRSABC):

- Danger.
- Response.
- Shout for help.
- Airway.
- Breathing.
- Circulation.

The procedure for assessing the collapsed patient and delivering in-hospital basic life support can be found in the RCUK guidelines (2015). The layout of the resuscitation trolley reflects this systematic approach to patient assessment and management and is usually comprised of separate airway, breathing and circulation drawers (Figure 1) **[Q5. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**. Ensuring the resuscitation trolley is sufficiently stocked with appropriate equipment is essential for safe practice. Equipment should be checked to ensure that:

- It has not expired.
- The packaging of single-use sterile equipment remains intact.
- It is in full working order, for example, the light source on the laryngoscope is functioning.
- No equipment is missing.
- Unnecessary equipment is not being inappropriately stored on the cardiac arrest trolley.

A defibrillator will often be found on the top of the cardiac arrest trolley. The types of defibrillator available ranges from an automated external defibrillator to a multifunctional manual device with a range of functionality that can also include cardiac monitoring for rhythm interpretation, the facility for transcutaneous pacing or synchronised cardioversion, along with defibrillation. This is often dependent on the acuity of the clinical area and local policy **[Q6. I'm not sure what you are trying to say here – please rephrase]**. Local policy will also dictate who is deemed competent to perform defibrillation in a cardiac arrest. Performance checks on the defibrillator should be carried out alongside trolley checking in accordance with the manufacturer's instructions. Defibrillators are often left plugged in to ensure that the battery is fully charged and ready for use. Nurses must remember to unplug the defibrillator before moving the trolley in an emergency situation.
Associated equipment that is also found on the top shelf of the trolley may include portable suction apparatus and personal protective equipment. An oxygen cylinder is frequently found attached to, or beside, the trolley.

Airway and Breathing

The maintenance of a patent airway is essential throughout resuscitation. While initial airway intervention consists of a head tilt, chin lift manoeuvre or a jaw thrust if head or spinal injury is suspected, the use of adjuncts may be considered to facilitate airway management. The most recent resuscitation guidelines (RCUK 2015) emphasise a stepwise approach to airway management, which may be achieved through a variety of approaches. Patient factors, for example, the degree of airway compromise, airway

anatomy or underlying conditions and the skills of the rescuer, will all determine the approach and the equipment used. The range of airway equipment available on the trolley reflects this stepwise approach and is listed in Box 1. **[Q7. The Box 1 we have is "Types of Cardiac Arrest" – Please insert correct box.]**

TIME OUT 2

The correct sizing of a simple airway adjunct is essential for safe and effective practice. Revise the recommended approach for sizing the oropharyngeal airway. In addition, if nasopharyngeal airways are available within your local healthcare organisations, revise the recommended approach for sizing the nasopharyngeal airway.

Simple airway adjuncts may be used to prevent airway occlusion from the tongue or soft pallet, and include oropharyngeal (Figure 2**[Q8. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**) and nasopharyngeal (Figure 3**[Q9. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**) airways. Nasopharyngeal airways may be particularly useful in a patient whose airway is compromised but who is not fully comatose and would therefore not tolerate an oropharyngeal airway adjunct. For patients who are deeply unconscious, including those in cardiac arrest, an oropharyngeal airway is often preferred. The correct sizing of the oropharyngeal airway is essential for safe and effective practice (Figure 4**[Q10. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**). Regardless of the airway adjunct, in cardiac arrest, ventilation is achieved with the use of a bag-valve-mask. Given the complexity of achieving an air-tight seal with the mask while maintaining a patent airway using a manual manoeuvre, a two-person technique is strongly recommended (Figure 5**[Q11. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**). **[Q12. Earlier you said that the breathing drawer was separate to the airway drawer. Please could you provide a list of the equipment you would expect to find in the breathing drawer?]**

Endotracheal tube intubation is a highly specialised skill that should only be performed by a clinician with the appropriate skills and expertise, ordinarily an anaesthetist. To fill the gap between the use of basic adjuncts and advanced airway management, supraglottic airway devices are more commonly used in resuscitation **[Q13. Please provide a reference for this. Please include reference in the reference list]**. Supraglottic airway devices include the 'classic' laryngeal mask airway or a supraglottic airway that conforms to the larynx and does not require inflation of the mask with air to create a seal.

While the responsibility for endotracheal intubation lies with the anaesthetist **[Q14. Your earlier sentence implied that it doesn't always have to be an anaesthetist ("should only be performed by a clinician with the appropriate skills…"– but this sentence**

implies that it does have to be the anaesthetist – please clarify], it is imperative that nursing staff are familiar with the equipment required for intubation. This is important in view of checking and restocking the trolley, and assisting with the endotracheal tube insertion itself. Specific equipment that may be required during intubation, and its clinical application, is described in Table 1 **[Q15. please insert Table 1]**.

Nurses should also be aware that once the endotracheal tube has been successfully inserted, CPR must be modified. Specifically, there is a change from a chest compressions to ventilation ratio of 30:2 – the delivery of 30 compressions followed by 2 ventilations – to continuous chest compressions **[Q16. Please check rewrite]**. One healthcare provider delivers 2 minutes of uninterrupted compressions while 10 ventilations are delivered independently. Ventilation is achieved following intubation by disconnecting the mask from the bag-valve-mask and connecting the bag directly to the endotracheal tube with or without the addition of a catheter mount (Figure 6).

The use of waveform end-tidal carbon dioxide ($ETC0_2$) monitoring, known as capnography, is emphasised within RCUK guidelines (2015). $ETC0_2$ may be used in resuscitation to:

- Confirm endotracheal tube placement within the respiratory tract.
- Provide insight into the quality of chest compressions.
- Indicate early return of spontaneous circulation.
- Highlight the potential futility of resuscitation (Kolar et al 2008 **[Q17. Does this reference refer to the last bullet point only, or to all 4 points? If it is only for the last point, please provide a reference for the first 3 points]**).

Given the increased emphasis placed on capnography in resuscitation, devices used to monitor waveform $ETC0_2$ may become more prominent alongside other resuscitation equipment.

Circulation

The provision of high quality chest compressions with minimal interruptions of less than 5 seconds is strongly advocated and has been shown to have a positive effect on patient outcomes (Sell et al 2010)**.** Chest compressions, when performed effectively, create an artificial circulation that ensures adequate coronary and cerebral perfusion. Comprehensive details of how to perform effective chest compressions can be found in the latest RCUK (2015) guidelines. Intravenous drugs are required to augment chest compressions; therefore, establishing vascular access is essential in supporting the circulation during resuscitation. A variety of peripheral vascular access devices and associated equipment, including flushes, syringes and dressings, will be found in the circulation draw of the trolley. Vascular access also allows for appropriate blood sampling and the administration of intravenous fluids. During resuscitation, crystalloid and colloid fluid types may be used to restore intravascular volume and to correct hypovolaemia. The equipment used to

administer intravenous fluids will also be found in the circulation drawer, including a variety of fluids and administration 'giving' sets**[Q18. I'm not sure what you mean by this? Please rephrase]**.

While the intravenous route is the most common for drug administration during resuscitation, if a vascular access device is not in place at the point of collapse, it may be difficult to achieve during resuscitation. The use of an intraosseous device is recommended to provide an alternative route for drug and fluid administration in critical illness and cardiac arrest (Lee et al 2015). Various intraosseous insertion devices are commercially available and may be present on the cardiac arrest trolley (Figure 7**[Q19. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**). The availability of these devices varies between healthcare organisations, therefore familiarisation with local policy, procedures and equipment lists is essential.

TIME OUT 3

Before reading the section on drugs, review the different types of cardiac arrest and ensure you can differentiate between shockable and non-shockable rhythms.

Drugs

While the standard range of drugs administered during resuscitation is limited, current guidelines continue to advocate the use of adrenaline (epinephrine) and amiodarone hydrochloride during cardiac arrest, despite a notable lack of evidence (RCUK 2015). Adrenaline is a sympathomimetic drug and potent vasoconstrictor (Benham-Hermetz et al 2012). Peripheral vasoconstriction following the administration of adrenaline leads to improved cerebral and coronary perfusion pressures, thereby augmenting CPR. For this reason, adrenaline is administered in all types of cardiac arrest (Box 2 **[Q20. Please note have renamed from Box 1 to allow for insertion of box in earlier query]**) and throughout the resuscitation attempt, at 3-5 minute intervals. The recommended dose of adrenaline in cardiac arrest is 1mg of a 1:10,000 concentration, which is 1mg in 10mL. This should not be confused with the 1:1,000 concentration that is used specifically for the management of anaphylaxis.**[Q21. Please provide a reference for these measurements. Please include reference in the reference list]** It is essential that nursing staff are able to differentiate between the two different concentrations of adrenaline that may be found on the trolley.

Box 2. Types of cardiac arrest

Arrhythmia associated with cardiac arrest is divided into two groups depending on the treatment required.

- Shockable rhythms are those that require defibrillation, namely ventricular fibrillation and pulseless ventricular tachycardia.
- Non-shockable rhythms refer to asystole and pulseless electrical activity. [Q22. Please check reformat – is this okay?]

Amiodarone is an antiarrhythmic drug that is used widely in clinical practice (Donovan 2006 **[Q23. Please provide a more recent reference for this. Please include reference in the reference list]**). In cardiac arrest specifically, it is administered to treat shockable rhythms that are resistant to defibrillation (shock refractory **[Q24. what do you mean by shock refractory? How does it fit into the sentence? Please rephrase]**). Current guidelines recommend the administration of 300mg after the third shock (RCUK 2015). In contrast to adrenaline, it is common practice to administer a single dose of amiodarone during resuscitation. However, a repeated dose may be given should the responsible clinician request it **[Q25. Please provide a reference. Please include reference in the reference list]**.

In cardiac arrest, drugs are routinely administered directly into the systemic circulation. Alternatives, such as the intramuscular or subcutaneous routes, are ineffective because of inadequate absorption and circulation. Consequently, the recommended routes in resuscitation are intravenous and intraosseous (Buck et al 2007). It is imperative that registered nurses deemed competent in infusion therapy are familiar with the drugs used in cardiac arrest, since they may be required to administer boluses of these medications during resuscitation. To facilitate rapid administration, cardiac arrest drugs are often available in pre-filled syringes (Figure 8**[Q26. Please would you provide a high resolution separate image file for this figure (the file size for each image should be around 5MB or more)]**). It is worth noting that registered nurses should be competent in all clinical aspects of infusion therapy and have validated competency **[Q27. I'm not sure what you mean by this? Please rephrase]** in accordance with the NMC Code (RCN 2010, NMC 2015). While cardiac arrest is a time-critical emergency situation, it is important to adhere to safe medicines management practice. Consequently, only registered nurses who routinely administer intravenous medications as part of their clinical role should undertake this skill in cardiac arrest. The NMC advocates that, wherever possible, two registrants should check the drug to be administered (NMC 2015). However, in an emergency situation, the checking process may involve one registered nurse and a pre-registration student. While a nursing student or a registered nurse who is not proficient in the administration of intravenous therapy may prepare the saline flushes, the registered nurse administering the intravenous medication should be the one to give them.

In practice, the accountable practitioner will often delegate the checking of the resuscitation trolley to a nursing student. It is, therefore, the nursing students' role to ensure that they are familiar with local policy and the contents of the trolley, including drugs.

TIME OUT 4

Are the following statements true or false?

- The intramuscular route is preferred for administering drugs during cardiac arrest.
- Amiodarone is used in all types of cardiac arrest.
- Adrenaline is a sympathomimetic drug and potent vasoconstrictor that improves cerebral and coronary perfusion pressure, thereby augmenting CPR.

Documentation, including cardiac arrest audit

The sequence of interventions during a cardiac arrest should be documented in a timely and chronological fashion. To facilitate optimum record-keeping, nurses may be involved in documenting periods of CPR, drug and fluid administration, and the use of the defibrillator, in real time. This information may also be used to complete the cardiac arrest audit documentation, which may contribute to local procedures while also informing the development of national guidelines. Any event where a patient receives chest compressions or defibrillation should be captured as part of the National Cardiac Arrest Audit. The purpose of this audit is to (ICNARC 2015):

- Improve patient outcomes.
- Decrease the incidence of avoidable cardiac arrests.
- Decrease the incidence of inappropriate resuscitation.
- Promote adoption and compliance with evidence-based practice.

TIME OUT 5

Locate and familiarise yourself with your local National Cardiac Arrest Audit form.

Conclusion

The availability of a fully-stocked emergency trolley and personnel who are familiar with its contents and the clinical application of each item is an essential component of a resuscitation attempt. Nursing staff also play an important role in restocking and replenishing the trolley following its use, reporting resuscitation equipment malfunction and documenting the sequence of events in cardiac arrest using the appropriate pro-forma **[Q28. do you mean "the appropriate forms"?]**.

Benham-Hermetz J, Lambert M, Stephens R (2012) Cardiovascular failure, inotropes and vasopressors. British Journal of Hospital Medicine. 73, 5, C74-C77.

Buck M, Wiggins B, Sesler J (2007) Intraosseous drug administration in children and adults during cardiopulmonary resuscitation. The Annals of Pharmacotherapy. 41, 10, 1679-1686.

Donovan K (2006) Amiodarone as a class III antiarrhythmic drug. British Journal of Cardiac Nursing. 1, 11, 530-539.

Intensive Care National Audit and Research Centre (ICNARC) (2015) National Cardiac Arrest Audit. https://www.icnarc.org/Our-Audit/Audits/Ncaa/About (Last accessed: 26 October 2016.)

Kolar M, Krizmaric M, Klemen P et al (2008) Partial pressure of end-tidal carbon dioxide successful predicts**[Q29. Should this be "predicts successful"?]** cardiopulmonary resuscitation in the field: a prospective observational study. Critical Care. 12, 5 **[Q30. Please provide the page numbers for the article?]**

Lee PM, Lee C, Rattner P et al (2015) Intraosseous versus central venous catheter utilization and performance during inpatient medical emergencies. Critical Care Medicine. 43, 6, 1233-1238.

National Patient Safety Agency (2008) National Reporting and Learning System: Quarterly Data Summaries **[Q31. Please provide the specific quarterly summary name]**. www.nrls.npsa.nhs.uk/resources/collections/quarterly-data-summaries (Last accessed: 26 October 2016.)

Nursing and Midwifery Council (2015). Standards for Medicines Management. NMC, London.

Resuscitation Council UK (2014) Quality standards for cardiopulmonary resuscitation practice and training. Resuscitation Council UK, London. **[Q32. Is this webpage the document you mean? www.resus.org.uk/quality-standards]**

Resuscitation Council UK (2015) Advanced Life Support. Seventh edition. Resuscitation Council UK, London.

Royal College of Nursing (2010) Standards for infusion therapy. Third edition. RCN, London.

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